University of Bahrain
College of Information Technology
Department of Computer Engineering

ITCE 202: Digital Logic
Test 1

Time: 1 hour **Date: April 6th, 2004**

Show all your work.
DO NOT USE CALCULATORS

Q1-

a) **(8-points)** Represent the following decimal numbers as 8-bits signed binary numbers in sign-magnitude, one's complement and two's complement format.

Decimal	sign-magnitude	one's complement	two's complement
+ 79			
- 49			

b) **(4 points)** Convert from Octal to BCD $(3.4)_8$ = ( )$_{BCD}$

c) **(6 point)** Convert $(8A9D)_{16}$ = ( )$_4$
= ( )$_8$

d) **(6 points)** Perform the following addition in binary using 7-bit 2's complement representation. Indicate if there is an overflow.
(-31) + (-56)

e) **(6 points)** Perform the following addition in BCD
947 + 735

Q2-

a) **(10 points)** Draw the logic circuit that corresponds to the following logic function (Do not Simplify).

$$F = \overline{\left[\ \left(A + \overline{B.C}\right) \oplus \overline{\left(A + B + C\right)}\ \right] .\ A\ .\overline{C}\ + D}$$

b) **(7 points)** Simplify the following expression to a minimum sum of products.

c) **(8 points)** Given that $F = W.X.\ \left[V.(\ \overline{X} + W)\ + \overline{Y.\ \overline{Z}}\right] + \overline{V}$

Use DeMorgan's theorem to find $\overline{F}$ and express $\overline{F}$ in a sum of products form.

Q3-Consider the following Boolean function:

$$F(A,B,C,D) = \sum m(0,2,4,5,7,8,10,14,15) + \sum d(6,13)$$

Express *F* in:

a) **(14 points)** Minimum Sum of products.
b) **(6 points)** Minimum Product of sums.

Q4- (25 points)

Given that:

$$F(A,B,C,D) = (B + C)(\overline{A} + \overline{C} + D)(\overline{A} + B)$$

a) Implement *F* as a minimum 2-level NAND gate network.
b) Using the minimum number of 2-input NOR gates only.

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Test 1I

Date: May 26th, 2004

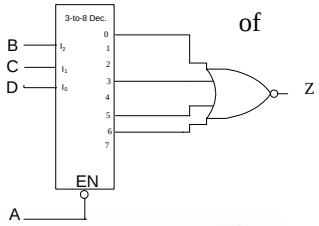
Q1 (20 points)

Implement the following function using an 8-to-1 MUX

$$F = (A + C)(A + \overline{C} + D)(\overline{A} + B + \overline{C} + \overline{D})$$

Q2- (20 points)

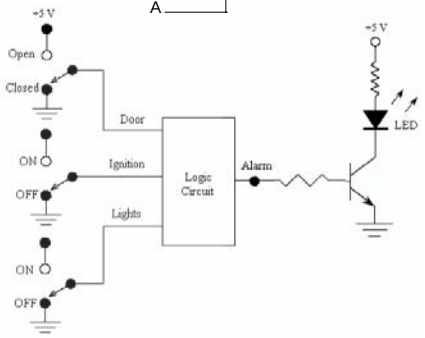
Design a circuit which will either subtract X from Y or Y from X, depending on the value of A, thus if A= 1, the output should be X-Y, if A=0, the output should be Y-X. Both X and Y are 4- bit binary numbers. You are allowed only to use full adders, Multiplexers and inverters. Draw a diagram showing your design.



Q3- (15 points)

The following figure shows a diagram for a car alarm circuit used to detect certain undesirable conditions. The three switches are used to indicate the condition of the door by the driver's seat, the ignition, and the headlights, respectively. Design the logic circuit with these three switches as inputs so that the alarm will be turned on (logical 1) whenever either of the following conditions exists:

- The headlights are on while the ignition is off.
- The door is open while the ignition is on.

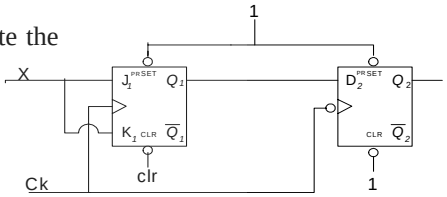


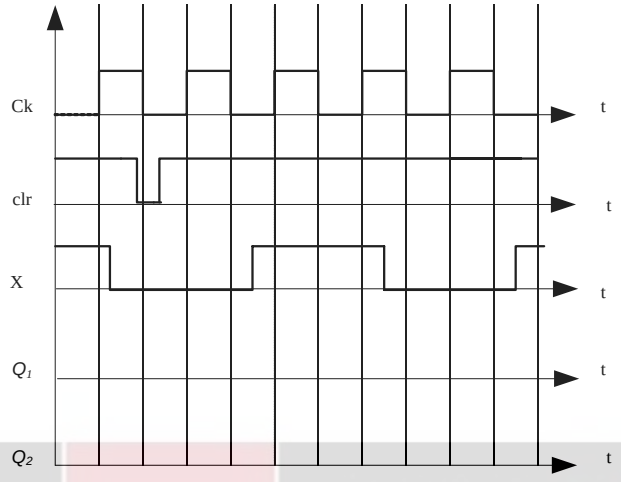
Q4 (15 points)

Express the output Z as a function of A,B,C,D for the following logic circuit in a minimum SOP form.

Q5- (15 points)

The circuit of Fig(5-a) contains a JK Flip-Flop and a D Flip-Flop. Complete the timing diagram of Fig 5-b by drawing the waveform of signals Q1, and Q2. Assume both Q1 and Q2 are initially zero





Q-6 (15 points)

The characteristic table of *R-I* flip-flop is as shown in table-6. Show how you can convert a *T* flip-flop to *R-I* flip-flop

Table-6

R	*I*	Q^+
0	0	$\overline{Q}$
0	1	0
1	0	1
1	1	0